CLAIMS

What is claimed is:

1. A hearing improvement device comprising:

a microphone for tranducing a sound field into a first electrical signal;

an amplifier for amplifying the first electrical signal into a second electrical signal; and

at least one inductor for converting the second electrical signal into a magnetic field for coupling to at least one telecoil of a hearing aid, wherein the microphone is amplified and coupled through the at least one inductor to the hearing aid.

2. The device according to claim 1, wherein the hearing aid comprises one of a behind-the-ear (BTE) hearing, an in-the-ear (ITE) hearing aid, an in-the-canal (ITC) hearing aid, and a completely-in-the-canal (CIC) hearing aid.

3. The device according to claim 1, wherein the microphone comprises an output connected to an input of a high-pass filter, the high pass filter being used to reduce low-frequency components of an electrical signal and avoid excessive low-frequency coupling to the hearing aid.

4. The device according to claim 1, wherein the at least one inductor comprises two inductors, wherein the first inductor is an in-the-ear (ITE) transmit inductor and the second inductor is a behind-the-ear (BTE) transmit inductor, wherein a switch is provided to at least one of enable the first inductor and disable the second inductor, enable the second inductor and disable the first inductor, enable the first and second inductors, and disable the first and second inductors.

5. The device according to claim 1, wherein the magnetic field emanating from the hearing improvement device comprise approximately 30 mA/meter at 1 kHz, wherein 1 kHz lies in range of frequencies comprising human speech.

6. The device according to claim 1, wherein the hearing improvement device is adapted to operate on an ear of a user by an earhook, wherein the hearing improvement device is positioned one of adjacent a user's outer ear and adjacent the user's head.

7. The device according to claim 1, wherein the hearing improvement device comprises one of an in-the-ear (ITE) transmit inductor and a behind-the-ear (BTE) transmit inductor positioned to magnetically couple with a vertically-oriented telecoil located within one of an ITE hearing aid and a BTE hearing aid, wherein lines of magnetic flux generated by one of the ITE transmit inductor and the BTE transmit inductor are arranged primarily vertically in a region within which one of the ITE hearing aid and the BTE hearing aid is located to optimize interaction with the vertically oriented telecoil located within one of the ITE hearing aid and the BTE hearing aid.

8. The device according to claim 1, wherein the at least one inductor comprises one of an in-the-ear (ITE) transmit inductor and a behind-the-ear (BTE) transmit inductor positioned to magnetically couple with a vertically-oriented telecoil located within one of an ITE hearing aid and a BTE hearing aid, wherein field strength of at least one of the ITE transmit inductor and the BTE transmit inductor are maximized by providing a core of at least one of the ITE transmit inductor and the BTE transmit inductor being sized to be contained within a limitation of space and orientation available in at least one of behind a user's outer ear and between the user's outer ear and the user's head.

9. The device according to claim 1, wherein the at least one inductor comprises one of an in-the-ear (ITE) transmit inductor and a behind-the-ear (BTE) transmit inductor positioned to magnetically couple with a vertically-oriented telecoil located within one of an ITE hearing aid and a BTE hearing aid, wherein at least one of the ITE transmit inductor and the BTE transmit inductor comprises a coil, wherein wire gauge and number of turns of the coil are chosen to give inductance and resistance values allowing peak current, wherein peak current comprises a level of current sufficient to drive an iron core of at least one of the ITE transmit inductor and the BTE transmit inductor to a saturation edge.

10. The device according to claim 1, wherein the at least one inductor comprises one of an in-the-ear (ITE) transmit inductor and a behind-the-ear (BTE) transmit inductor positioned to magnetically couple with a vertically-oriented telecoil located within one of an ITE hearing aid and a BTE hearing aid, wherein at least one of the ITE transmit inductor and the BTE transmit inductor comprises a coil, the coil comprising windings, wherein the windings of at least one of the ITE transmit inductor and the BTE transmit inductor are used for coupling to telecoils of at least one of the ITE hearing aid and the BTE hearing aid.

11. The device according to claim 1, wherein the at least one inductor comprises one of an in-the-ear (ITE) transmit inductor and a behind-the-ear (BTE) transmit inductor positioned to magnetically couple with a vertically-oriented telecoil located within one of an ITE hearing aid and a BTE hearing aid, wherein at least one of the ITE transmit inductor and the BTE transmit inductor comprises a coil, the coil comprising windings, wherein at least one of the ITE transmit inductor and the BTE transmit inductor are divided into two windings spaced a distance apart by a winding gap and the two windings are positioned on a common core, wherein the two windings are adapted to improve uniformity of the magnetic fields induced by at least one of the ITE transmit inductor and the BTE transmit inductor.

12. The device according to claim 1, wherein the at least one inductor comprises one of an in-the-ear (ITE) transmit inductor and a behind-the-ear (BTE) transmit inductor positioned to magnetically couple with a vertically-oriented telecoil located within one of an ITE hearing aid and a BTE hearing aid, wherein at least one of the ITE transmit inductor and the BTE transmit inductor comprises a coil, the coil comprising windings, wherein the windings of at least one of the ITE transmit inductor and the BTE transmit inductor extend as close as practical to an end of the core to maintain a uniform field near ends of the core.

13. The device according to claim 1, wherein the at least one inductor comprises an inductor pair positioned to magnetically couple with a vertically-oriented telecoil located within one of an ITE hearing aid and a BTE hearing aid, wherein at least one of inductors of the inductor pair comprises a coil comprising at least two windings spaced a distance apart by winding gaps, wherein the winding gaps of each inductor of the inductor pair permits inductors to overlap within respective winding gaps to minimize thickness of the inductor pair.

14. The device according to claim 1, wherein the hearing improvement device produces a flat frequency response at an output of a receiving telecoil, wherein frequency-dependent drive voltage response compensates for a combined frequency response, and wherein a transmit inductor drive voltage produces a flat receiving telecoil frequency response, and wherein overall magnetic coupling response is uniform over a speech frequency range.

15. The device according to claim 1, wherein the at least one inductor comprises an inductor pair, each inductor of the inductor pair comprises at least two windings spaced a distance apart by a winding gap, wherein the winding gaps of each inductor of the inductor pair permit one inductor of the inductor pair to overlap another inductor of the inductor pair at respective winding gaps of each inductor, wherein the overlapped inductors avoid buildup of field strength near a center of each inductor that would occur with a continuous winding, and wherein the overlapped inductors provide a magnetic field adapted to couple to a variety of hearing aids types comprising a range of receiving telecoil positions.

16. The device according to claim 1, wherein the hearing improvement device is positioned adjacent to the hearing aid, the hearing improvement device being located behind an ear and next to the head of a user providing coupling of a magnetic field generated by a transmit inductor coil within the hearing improvement device to a receiving telecoil located within the hearing aid having uniform magnetic coupling strength over a range of telecoil positions within the hearing aid.

17. The device according to claim 1, wherein the hearing aid is one of connected via a wired connection to the hearing improvement device and connected wirelessly to the hearing improvement device.

18. The device according to claim 1, wherein the hearing improvement device is adapted to connect to one of one earphone and two earphones.

19. A hearing improvement device comprising:

a wireless mobile handset for converting a radio frequency signal into an electrical signal; and

at least one inductor for converting the electrical signal into a magnetic field for coupling to at least one telecoil of a hearing aid.

20. The device according to claim 19, wherein the wireless mobile handset comprises a cellphone, wherein the hearing improvement device facilitates efficient coupling of received audio signals from the cellphone to the telecoil in a hearing aid of a user.

21. The device according to claim 19, wherein the at least one inductor comprises a plurality of inductors arranged in an array, wherein the array of inductors is disposed within the wireless mobile handset, the wireless mobile handset comprises a cellphone, and wherein the array of inductor is adapted to couple audio signals from the cellphone to the telecoil in a hearing aid of a user via one of a wired or wireless connection.

22. The device according to claim 19, wherein the wireless mobile handset comprises a cellphone, wherein the cellphone is one of an analog cellular telephone and a digital cellular telephone.

23. The device according to claim 22, wherein the cellphone is adapted to operate according to at least one a code division multiple access (CDMA) standard, a time division multiple access (TDMA) standard, and a global system for mobile communications (GSM) standard.

24. The device according to claim 19, wherein the hearing aid comprises one of a behind-the-ear (BTE) hearing, an in-the-ear (ITE) hearing aid, an in-the-canal (ITC) hearing aid, and a completely-in-the-canal (CIC) hearing aid.

25. The device according to claim 19, wherein the at least one inductor comprises a plurality of inductors.

26. The device according to claim 19, wherein the hearing improvement device is adapted to generate magnetic fields comprising approximately 30 mA/meter at 1 kHz, wherein 1 kHz lies in range of frequencies comprising human speech.

27. The device according to claim 19, wherein the at least one inductor comprises at least one transmit inductor positioned to magnetically couple with a vertically-oriented telecoil located within the hearing aid, wherein lines of magnetic flux generated by the at least one transmit inductor are arranged primarily vertically in a region within the hearing aid to optimize interaction with the vertically oriented telecoil located within the hearing aid.

28. The device according to claim 19, wherein the at least one inductor comprises at least one transmit inductor positioned to magnetically couple with a vertically-oriented telecoil located within the hearing aid, wherein field strength of the transmit inductor is maximized by providing a core being sized to be contained within a limitation of space and orientation available in the wireless mobile handset.

29. The device according to claim 19, wherein the at least one inductor comprises at least one transmit inductor positioned to magnetically couple with a vertically-oriented telecoil located within the hearing aid, wherein the at least one transmit inductor comprises a coil, wherein wire gauge and number of turns of the coil are chosen to give inductance and resistance values allowing peak current, wherein peak current comprises a level of current sufficient to drive an iron core of the at least one transmit inductor to a saturation edge.

30. The device according to claim 19, wherein the at least one inductor comprises at least one transmit inductor positioned to magnetically couple with a vertically-oriented telecoil located within the hearing aid, wherein the at least one transmit inductor comprises a coil, the coil comprising windings, wherein the at least one transmit inductor is divided into at least two windings spaced a distance apart by a winding gap and the at least two windings are positioned on a common core, wherein the at least two windings are adapted to improve uniformity of the magnetic field induced by the at least one transmit inductor.

31. The device according to claim 19, wherein the at least one inductor comprises at least one transmit inductor positioned to magnetically couple with a vertically-oriented telecoil located within the hearing aid, wherein the at least one transmit inductor comprises a coil, the coil comprising windings, wherein the windings of the at least one transmit inductor are adapted to extend close to ends of a core of the transmit inductor to maintain a uniform field near ends of the core.

32. The device according to claim 19, wherein the at least one inductor comprises at least two transmit inductors positioned to magnetically couple with a vertically-oriented telecoil located within the hearing aid, wherein the at least two transmit inductors comprise coils, the coils comprising windings, wherein the windings are divided into at least two windings spaced a distance apart by winding gaps on each of the at least two transmit inductors, wherein the winding gaps permit one transmit inductor to overlap a center of another transmit inductor to minimize thickness of an inductor pair while allowing the one transmit inductor to be positioned to couple with the at least one telecoil in the hearing aid.

33. The device according to claim 19, wherein the hearing improvement device produces a flat frequency response at an output of a receiving telecoil, wherein frequency-dependent drive voltage response compensates for a combined frequency response, and wherein a transmit inductor drive voltage produces a flat receiving telecoil frequency response, and wherein overall magnetic coupling response is uniform over a speech frequency range.

34. The device according to claim 19, wherein the at least one inductor comprises an inductor pair, each inductor of the inductor pair comprises a coil having at least two windings spaced a distance apart by a winding gap, wherein the winding gap of each inductor of the inductor pair permit one inductor of the inductor pair to overlap another inductor of the inductor pair at the winding gap of each inductor, wherein the overlapped inductors avoid buildup of magnetic field strength near a center of each inductor that would occur with a continuous winding, and wherein the overlapped inductors provide a magnetic field adapted to couple to a variety of hearing aids types comprising a range of receiving telecoil positions.

35. The device according to claim 19, wherein when the wireless mobile handset is positioned adjacent to the ear of a user wearing the hearing aid, the wireless mobile handset provides a coupling magnetic field generated by a transmit inductor coil within the wireless mobile handset to a receiving telecoil located within the hearing aid and has a uniform magnetic coupling strength over a range of telecoil positions within the hearing aid.